Environmental Technologies Acceptance (ETA) Program: NETL–EERC Cooperative Agreement

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Introduction

The Energy & Environmental Research Center (EERC) at the University of North Dakota supports a full-time, multidisciplinary professional staff and state-of-the-art testing and laboratory facilities that conduct work to minimize commercialization barriers through customized programs of technical support, partnership brokering, systems engineering, and field demonstrations. Under Environmental Management (EM) Cooperative Agreements with the National Energy Technology Laboratory (NETL), the EERC has instituted "hands-on" focused technical support, partnership brokering, and field demonstrations that provide a vehicle for rapid commercialization and deployment. The EERC is currently conducting an EM Cooperative Agreement, the Environmental Technologies Acceptance (ETA) Program, which allows the EERC to continue to assist industry partners to help the U.S. Department of Energy (DOE) meet its 2006 goals through the development of safe, cost-effective, and efficient technologies.

Problem Definition

Technology commercialization can be hampered by many factors, including limited capital, limited capabilities for testing and demonstration and, specific to the EM Program, a limited knowledge of DOE and EM site needs. Deployment of any technology in the highly competitive EM marketplace requires sound data from field tests that clearly demonstrate the superior capabilities of the technology, knowledge of site plans and personnel, and the potential to incorporate the technology into the ongoing site cleanup activities with minimal disruption.

Recognizing that commercialization also hinges on the successful resolution of technical issues outside the traditional focus of the technology developer, the ETA Program builds on the experience and expertise gained by the EERC through the EM Cooperative Agreement to continue to enhance and accelerate the commercialization of environmental technologies for the EM Program.

Objectives

The objectives of the ETA Program are to advance development, commercial acceptance, and timely deployment of selected private sector technologies. Through the ETA Program, the EERC works with technology developers, DOE end users, and NETL personnel with the ultimate goal of increasing technology deployments at EM sites.

Approach

Two types of partnerships are developed in the ETA Program. The EERC provides expertise and technical resources to private sector companies for technology commercialization, and the EERC develops new technologies using in-house research, development, and demonstration that lead to commercialization partnerships with the private sector.

The ETA Program is divided into four tasks. Tasks 1–3 involve technology selection, technology development, and technology verification, respectively. Activities under Task 4 ensure that site managers are knowledgeable with respect to the improved efficiencies and safety represented by the innovative technologies advanced under Tasks 1–3. The four ETA Program tasks are as follows.

Task 1 – Technology Selection
Technologies have been and will continue to be reviewed in collaboration with their developers, potential site users, and EM program managers to match technologies with site needs.

Task 2 – Accelerated Technology Development
Technical support is being provided to four current industry partners to resolve process problems posing barriers to deployment at DOE sites. This task includes all experiments or other nonexperimental development work that will be performed as well as any analytical work needed. The purpose of this task is to provide technical expertise to solve technical problems and accelerate technology development.

Task 3 – Technology Verification
Engineering design data and cost information will be developed through pilot-scale and field testing to support site deployment.

Task 4 – Systems Engineering
The activities of this task will promote the overall program objective of advancing the development, commercial acceptance, and deployment of new technologies complexwide. This will be achieved by developing systems to facilitate efficient and direct interaction between the technology users and the technology developers.

Project Description

Under the ETA Program, the EERC is working closely with DOE program managers, technology developers, and clients at EM cleanup sites to match candidate technologies with priority needs. In addition, the ETA Program will accelerate technology development and site deployment by providing scientific and engineering support, verification testing, technical and economic assessment, and coordination to advance the development, commercial acceptance, and timely deployment of selected private sector technologies for cleanup at DOE EM sites. There are currently five primary activities being conducted under the ETA Cooperative Agreement.

1. The EERC is participating as a team member for the Long-Term Stewardship (LTS) Initiative for the Miamisburg Environmental Management Project (MEMP) at the Mound plant site in Ohio.

2. The EERC, in partnership with ADA Technologies in Denver, Colorado, is investigating a photocatalytic process for treating mercury-contaminated waters.

3. The EERC is demonstrating a patented subcritical water treatment technology using samples of contaminated paint waste from the CMS Energy facility in Charlevoix, Michigan. This technology has the potential to be an alternative for management of orphaned contaminated paint wastes from deactivation and decommissioning (D&D) activities.

4. The EERC, in partnership with Ecolotree, Inc., in North Liberty, Iowa, is developing an alternative vegetative cover design for low-level waste (LLW) repositories. The "Century Cap" is designed to limit hydraulic infiltration for hundreds of years by integrating vegetation with high growth and transpiration rates with late successional vegetation having similar characteristics.

5. As an extension of previous work to provide decision support tools for the D&D focus area (DDFA), the EERC is converting the current information system for this focus area to a Web-based platform. In addition, the EERC is working with representatives of all of the focus areas to develop a National Focus Area Information System.

Accomplishments and Future Activities

Initiated in July of 2000, ETA Program activities enter their second year focused on advancing four technologies, as summarized in Table 1, and on marketing these and other innovative technologies to site managers.

LTS Initiative at Mound, Ohio. Site needs for LTS can be generally characterized as either requirements for institutional controls and information management or monitoring for containment effectiveness. The EERC is serving on the Project Management Team of the LTS Initiative for the MEMP at the Mound Plant Site in Ohio. The overall goal of this project is to

Table 1. ETA Year 1 Technology Development Activities

Activities	Industrial Partners	Activity Scope
LTS Initiative at Mound, OH	DOE Mound and BWXT Ohio	Team Member for the LTS Initiative, MEMP, Mound Plant Site, OH
Photocatalytic Treatment of Hg-Contaminated Water	ADA Technologies, Denver, CO	Characterize and enhance a photocatalyst for aqueous Hg treatment to optimize the treatment process
Subcritical Water Treatment of Pb and PCB-Contaminated Paint	Consumers Energy Company (subsidiary of CMS Energy), Charlevoix, MI	Demonstrate subcritical water treatment technology as an alternative for management of orphaned contaminated paint waste from D&D activities
"Century Cap" for Low-Level Radioactive Waste Repositories	Ecolotree, North Liberty, IA, and DOE Savannah River Site	Develop a "Century Cap" designed to last for hundreds of years by integrating vegetation with high-growth and transpiration rates with late-successional vegetation having similar characteristics

assist the MEMP LTS Initiative in its assessment of site needs and search and screening of technologies to meet these needs.

DOE and support contractor personnel at the Mound site will be conducting their own site-specific needs assessment for LTS. The EERC will concurrently conduct a complexwide LTS needs assessment to provide a context for the Mound assessment and to provide summary information about LTS needs throughout the complex. In addition, the EERC's comprehensive assessment will be used by Mound to identify test platforms (when on-site facilities are not available) to demonstrate and evaluate prospective technologies considered for site LTS applications. The EERC will also collaborate with members of the Project Management Team in identifying, evaluating, and/or developing technologies to address LTS needs as well as participate in LTS planning activities for the site.

Photocatalytic Treatment of Hg-Contaminated Water. The EERC is working with ADA Technologies, Inc., of Englewood, Colorado, to enhance the performance of ADA's photocatalytic process for mercury removal from water. Specific objectives of this phase of work involve 1) detailed characterization of the sorbent materials using scanning electron microscopy (SEM) coupled with energy-dispersive spectrometry and x-ray diffraction (XRD) techniques and 2) verification of mercury removal efficiencies under a variety of loading conditions in a laboratory-scale photocatalytic reactor using surrogate waste streams to verify previous test results and provide additional treatment efficiency data to supplement the existing treatment database.

Seven different sample types representing different stages of catalyst production and use have been characterized using XRD and SEM. A 20-L, laboratory-scale photocatalysis reactor system

has been designed and fabricated to verify previous catalyst performance and to optimize sorbent utilization using a different reactor configuration. Hydrostatic testing is ongoing, and catalyst performance verification testing will begin soon.

Subcritical Water Treatment of Pb- and PCB-Contaminated Paint. This activity further demonstrates the subcritical water treatment technology developed at the EERC by evaluating its use in remediating the increasing volumes of PCB (polychlorinated biphenyl)- and lead-laden paint from D&D activities. The overall goal of the project is to evaluate an alternative treatment process that will allow regulatory-compliant disposal of PCB- and radionuclide-contaminated paint waste created from D&D activities. The objectives are to determine and develop the ability of subcritical water to either 1) selectively remove PCBs from the bulk paint matrix to generate separate PCB- and radioactively contaminated wastes which can then be disposed of in a conventional manner and/or 2) dechlorinate PCBs in the bulk paint matrix so that the total PCB concentration is reduced below levels of concern.

Representative waste paint chips (PCB- and metal-contaminated [lead and chromium] but not radioactively contaminated) have been supplied by CMS Energy. These paint chips are being subjected to subcritical water conditions to determine the potential for either removal or destruction of the bulk paint. In the present studies, the fate of the lead and chromium during the process will also be determined for representative samples.

Results from laboratory testing to date show that the PCB composition in the paint samples is similar to the commercial mixture Aroclor 1254. The individual PCB concentrations were in the range of 1 to 40 ppm, corresponding to a total PCB concentration of approximately 130 ppm. Preliminary subcritical water treatment experiments were performed for the paint samples and an Aroclor 1254 standard. Results show no significant degradation occurred for the Aroclor 1254 standards, but there was significant dechlorination of hexa- and heptachorinated biphenyls to tetrachlorinated biphenyls attributable not only to the temperature of the subcritical water but also to the additives present in the paint. At 350°C, the total content of PCBs in the paint sample decreased 55±6%. Future studies will include the possibility that paint additives (e.g., lead) enhance PCB chlorination.

“Century Cap” for Low-Level Radioactive Waste Repositories. The EERC is working with Ecolotree, Inc., of North Liberty, Iowa, on developing a long-term cover system (“Century Cap”) for LLW disposal cells at DOE sites. Ecolotree has designed vegetative caps capable of shielding wastes from percolating water over time. For this project, vegetation with high growth and transpiration rates will be integrated with late-successional vegetation having similar characteristics, with the overall goal of developing a Century Cap for LLW repositories. Criteria include a design life of 100 years or longer, minimal maintenance requirements, and compatibility with humid environmental conditions. Specific objectives include 1) defining specific vegetative cover needs for LLW repositories in humid environments, 2) collecting data required for design and modeling of a vegetative cover, 3) designing and modeling vegetative covers, and 4) evaluating the costs and transferability of the design to other LLW repositories in the DOE complex. Ecolotree will utilize the HYDRUS-2D model during cover design.

Task 4 Activities

The systems engineering activities emphasize the development of a decision-making tool that provides users with a method for examining relationships between technologies and site needs. This tool is based on, and is an expansion of, the system that has been successfully developed and used by DDFA. It is based on a three-tier hierarchical classification model. The three tiers are based upon assessments of the need or technology in terms of problem area, media, and contamination/remediation objective. Needs and technologies are matched using an algorithm based upon these classifiers. In addition to relating needs and technologies, the tool will identify "technology gaps" (needs without technologies) and high-value technologies—those that apply to multiple needs complexwide.

While needs are obtained from existing site data systems, the technologies are researched through peer-reviewed and gray literature as well as through vendor information sources. As appropriate, new technologies or those previously unknown to the DOE complex are evaluated by the EERC for consideration in the technology data set.

A feature of this Web-based decision-making tool will be a Technology Vendor Link. This link will enhance DDFA's role in providing technical assistance and information dissemination. The Web site will be linked directly to the product Web page of the technology vendors. New vendors have the opportunity to add their product link by submitting their information directly to DDFA through the Web site.

Future work under this task will include the development of a national focus area information system that will provide the same level of decision-making support to all the focus areas. This includes the benefits of uploading information directly into the Integrated Planning Accountability and Budgeting System.

Summary

The objective of the ETA Program at the EERC is to advance the development, commercial acceptance, and timely deployment of selected private sector technologies for the cleanup of sites in the nuclear defense complex as well as the greater market. The program consists of four tasks: Technology Selection, Technology Development, Technology Verification, and System Engineering. There are currently four technical subtasks: Long-Term Stewardship Initiative at the Mound Plant Site; Photocatalysis of Mercury-Contaminated Water; Subcritical Water Treatment of PCB and Metal-Contaminated Paint Waste; and Vegetative Covers for Low-Level Waste Repositories. The ETA Program is currently advancing these four technologies and is actively seeking partnerships with other technology developers and sites for this service.

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